Greek Musicologists in the Roman Empire

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The science of harmonics, like so many others, reached a remarkable level of sophistication in Greece during the fourth century BC.[1] For the next three hundred years it seems to have been almost entirely neglected: at any rate, no texts from that period survive, and when treatises on the subject reappear, around the time of Augustus, they show no sign that anything of serious significance had happened in the mean time. But in the first two or three centuries of the imperial period harmonics enjoyed a major

1 The direct evidence is impressive, though not very extensive. Most significant are the various discussions in Plato's dialogues (especially *Republic* 530c-531c, *Timaeus* 34b-36d, *Philebus* 17b-e with 25a-26a, 55e-56a), and the surviving remains of Aristoxenus's work in the field, now known as the three books of his *Elementa Harmonica* (the best modern edition is that of R. Da Rios, Rome 1954: English translation and notes in *GMW* 2). Aristoxenus includes illuminating discussions of some of his predecessors. Additional evidence comes from occasional remarks in Aristotle and from various parts of the pseudo-Aristotelian corpus (especially Book XIX of the *Problems*): writers of the Roman period give a number of further reports and putative quotations, some of which contain material of great importance, if indeed it is authentic. Notable examples are the various citations of Aristoxenus in the pseudo-Plutarchan *De Musica*, the account given by Ptolemy (mainly in *Harmonics* I.13-14) of the work of Archytas, and the passages set out as fragments of the writing of Philolaus by Nicomachus in *Enchiridion* 9 and by Stobaeus at *Anth.* i.21,7b.

revival: a dozen or so treatises have come down to us complete, along with substantial fragments of at least ten others, and these, no doubt, are only a fraction of the number that were actually in circulation.[2] A revival on that scale can hardly be an accident; and in pursuing the theme of relations between science and society, I shall be trying to say a little about the niches that this rather esoteric Greek science found for itself in the new intellectual and social milieu of the early empire, and about the new forms that it adopted in fitting itself to this society's requirements.

Technical treatises on harmonics are not everyone's idea of cosy bedtime reading, and even quite eminent classicists may be forgiven a certain degree of vagueness when challenged to say what exactly this science is. Hence a preliminary word or two about its general character and aims

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2 Those that are complete, or nearly so, include Nicomachus, *Enchiridion* (in *MSG*: reprinted with Italian translation and notes in *MMG*; English translation and commentary in *GMW* 2 and in F.R. Levin, *The Manual of Harmonics of Nicomachus the Pythagorean*, Grand Rapids 1994); Ptolemy, *Harmonics* (ed. I. Düring, Göteborg 1930: German translation and notes in Düring's *Ptolemaios und Porphyrios über die Musik*, Göteborg 1934; English translation and notes in *GMW* 2); Porphyry, *Commentary on Ptolemy's Harmonics* (ed. I. Düring, Göteborg 1932); Aristides Quintilianus, *De Musica* (ed. R.P. Winnington-Ingram, Leipzig 1963: English translation and notes in T.J. Mathiesen, *Aristides Quintilianus: On Music in Three Books*, New Haven and London 1983, and *GMW* 2); the short 'handbooks' of Cleonides, Bacchius, Gaudentius and Alypius (all in *MSG* and *MMG*: English translation of Cleonides in Strunk 1981; of Bacchius in Steinmayer 1985); the three short treatises known as the *Anonyma Bellermanniana* (ed. D. Najock, Leipzig 1975: text with German translation and commentary in Najock's *Drei anonyme griechische Traktate über die Musik*, Göttingen 1972); and in a slightly different category, the pseudo-Plutarchan *De Musica* (ed. with French translation, commentary and copious additional materials in F. Lasserre, *Plutarque de la musique*, Olten and Lausanne 1954; ed. with English translation by B. Einarson and P.H. De Lacy in vol. 14 of the Loeb *Plutarch's Moralia*, London 1967; English translation and notes in *GMW* 1). As substantial fragments we have, for instance, large parts of Theon Smyrnaeus, *Expositio rerum mathematicarum ad legendum Platonem utilium* (ed. E. Hiller, Leipzig 1878); passages from the writings of Thrasyllus and Adrastus, embedded in Theon's treatise; valuable excerpts from writers including Ptolemaïs of Cyrene, Didymus, Heraclides, Aelianus and Panaetius, quoted by Porphyry in his *Commentary*; ten pages or so of material from another work by Nicomachus (in *MSG* and *MMG*); a curious collection of miscellaneous jottings, quite falsely — one might even say libelously — attributed in the MSS to Ptolemy, and known as the *Excerpta Neapolitana* (in *MSG* and *MMG*); and of course a great many brief citations and reports in other scientific or literary works of the period.

may not be out of place. It has nothing to do with 'harmony', in our sense of the expression. Its subject is melody; and its primary task is to analyse the elements and structures out of which melodies are built, and to explore their permutations and interrelations. Most characteristically, it studies the relations between pitches in the structures we might call musical 'scales', or patterns of attunement. It also seeks to explain what it is about properly musical patterns of notes and intervals that makes them musical — why it is that from certain arrangements of sounds we can elicit pure magic, but only garbage from others. The Greeks were pretty well unanimous in treating this distinction as sharp and objective: hence the question what the difference is, and what makes it the difference between music and nonsense, demanded an objective and scientific answer.

Two completely different approaches to these issues developed during the late fifth century, and reached maturity in the fourth. The contrasts between them are complex and fascinating, but here I can only hint at them; and I must at least do that, since much of what I shall be saying later depends on them.[3] On the one hand, then, we have a school that can loosely be called 'Pythagorean' or 'Platonist', mathematical in inspiration and method, representing intervals between notes as ratios between numbers, and well-attuned patterns of intervals as mathematically coordinated systems of ratios. The musical qualities of such forms of attunement were explained as reflections of the mathematical coherence of the relations they exemplified. And since the same, abstract mathematical form may be found in complexes of many different sorts, this style of harmonics readily extended itself into much wider speculations, in which the mathematical proportions which brought harmonious and coherent unity to a diverse plurality of sounds were held to be responsible also for the 'harmony' of a virtuous human soul, a healthy body, a pleasing combination of colours, the intricate dance of stars and planets, and the divine order of the cosmos as a whole.[4]

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3 A brief review of the distinctions is in *GMW* 2: 3-11. Some details of the work done in each of the traditions will be found in West 1992: chap. 8.

4 For indications of some early extensions of harmonic theory into other domains see the passages from Philolaus and Plato cited in n. 1, and for later developments see for example the following, from the works cited in n. 2: Theon of Smyrna, passim; Nicomachus, *Ench.* 3; Ptolemy, *Harm.* III; Aristides Quintilianus *De Mus.* III. For illuminating discussion see W. Burkert 1972: esp. chaps. 4, 5, 6.4.

The second approach to harmonics, best represented in the magisterial work of Aristoxenus, has no such intoxicating ambitions. For Aristoxenus, melody or attunement is a 'nature' that exists, and can exist, only in the domain of sound. His science is an Aristotelian exploration of this nature, and it says nothing whatever about 'natures' of any other kind. The laws of melody are its own, not borrowed from the wider sphere of mathematics or physics or anything else. In intention at least, this science is empirical, seeking to describe and analyse what is experienced, heard as melody, and the qualities that present it as musical melody to our hearing; and it follows immediately that the language of Pythagorean mathematics is quite the wrong medium through which to pursue it.[5] In hearing a sequence of sounds as a melody, we do not hear them as quantities standing to one another in numerical ratios. The language that best expresses what we do hear, in hearing something in the guise of melody, is the language developed to describe music, over the centuries, by musicians themselves; and that is the source from which the vocabulary of Aristoxenian harmonics is developed. It lacks the minute precision of the rival, mathematical terminology: on the other hand it is incomparably richer in the range of distinctions and nuances of musical meaning it can convey. It also stays much closer to the phenomena of real musical experience, since it is deliberately designed to be as direct as possible a verbal representation of the form that this experience takes.[6] By contrast, the Pythagorean approach, for all its other virtues, is not only significantly distanced by its vocabulary from the perceived character of the musical 'given': it is also perennially subject to the temptation of privileging relations which are understood, intellectually, as mathematically correct over those that are perceived as musically acceptable.

Let me now offer a brief, preliminary sketch of what happened to these two traditions of harmonic science when they entered the world of the Roman empire. Attempts to bring them together are few and mostly perfunctory, though we shall look in a little detail, later on, at one example that does deserve to be taken seriously from a sober, scientific perspective. By and large they remained in water-tight intellectual com-

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5 Cf. Aristoxenus *El. Harm.* 32.18-28.

6 For a valuable discussion of Aristoxenus's language, see Bélis 1986: chap. 5.

partments, just as they had been in the fourth century. What is new, in this new kind of society, is that their social spheres of operation, the categories and levels of readership for which the treatises arising from them were designed, seem also to have split apart.

Essays of the Pythagorean sort, mathematically sophisticated and sometimes genuinely original in their arguments and insights, metaphysically ambitious if musicologically unadventurous, are found most often in commentaries on the works of Plato, especially on the *Timaeus*. Characteristic examples are our fragments of the writings of Thrasyllus (best known for his tenure of the position of astrologer to the emperor Tiberius), Adrastus at the end of the first century (usually but rather misleadingly designated as Adrastus the Peripatetic; a writer of sharp intelligence and mathematical acumen), and his near-contemporary Theon of Smyrna, the title of whose book speaks for itself: *Mathematics Useful for Reading Plato*. We have traces of a good many others that seem to have belonged to the same genre, commentaries that try to shed light on Platonic writings and on the truths they convey, through mathematical development of the harmonic analyses that are taken to underlie them.[7] The major work of Nicomachus, now lost, but paraphrased into Latin by Boethius,[8] was clearly a close relative of such essays: not a commentary on Plato, but still concerned almost exclusively with the complexities of harmonic and metaphysical mathematics. Though they take harmonic analysis as their main conceptual resource, such works tell us very little about music. They are conceived primarily as contributions, through a special kind of mathematics, to the loftiest regions of philosophy — a conception whose initial inspiration is itself Platonic, of course, derived from the account of the philosopher's mathematical education which is sketched in Book VII of the *Republic*. The readership for which they are designed is erudite, philosophically inclined, capable of grasping sophisticated mathemati-

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7 Examples are the fragments of Aelianus quoted at Porphyry, *Comm.* 33.16-37.5 and 96.7-15 (from his commentary on the *Timaeus*), and of Panaetius at *Comm.* 65.21-67.10 (though not necessarily in a wholly Platonist context: the work's title is given as *Concerning the ratios and intervals in Geometry*).

8 *De institutione musica libri quinque*, ed. G. Friedlein (Leipzig 1867), translated by C. Bower as *Fundamentals of Music* (New Haven and London 1989). The issue of its relation to the works of Nicomachus is well discussed in Bower's introduction.

cal concepts and of following complex, sometimes quite original mathematical arguments. It is an audience of specialists, not a large general public, and of specialists already well advanced in several branches of intellectual endeavour, by no means beginners.

The surviving Aristoxenian treatises are of a wholly different complexion. Faithful to their source (at least in this respect), their subject is musical structure and nothing else. As is to be expected, they show no interest in serious mathematics: what is more surprising is their apparently complete lack of methodological self-awareness, their neglect of philosophical issues touching the basis of the science they pursue, and their innocence, by and large, of developed argumentation of any sort. Set beside the works of Aristoxenus himself they make depressing reading. Even in the purely musicological domain they are far from being records of original thought or even of fresh observation. The arid little essays of Cleonides, Bacchius, Gaudentius and the second of the writers known as 'Bellermann's Anonymi' consist of almost nothing but potted summaries of Aristoxenian doctrine, shorn of the sparkling discursive reflections of their model and adding nothing in their place. Unlike the Pythagorean writings, this tradition of harmonics seems somehow to have slipped downhill in the intellectual world. The word that springs to mind is 'scholastic'; and it points in the right direction, for some of these writings, if not all, are unquestionably school texts. Bacchius and Gaudentius, in particular, have 'schoolteacher' written all over them, and we can find close parallels for the style and form of their text-books in contemporary pedagogic writings on other subjects.[9]

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9 The 'catechistic' approach of Bacchius can be paralleled in many examples of ancient pedagogy: see, e.g., Marrou 1956: 168, 279-80. The emphasis on rote-learning in secondary schools, amply documented by Marrou and reflected in Bacchius, is delightfully exemplified in British Library Add. MS. 37516, illustrated and discussed in Kenyon 1909. Gaudentius is rather different, a little more relaxed and civilized, but still detectably of the same company. In the MSS he is given the portentous title 'The Philosopher', which if taken in any of its familiar senses is plainly not earned by the contents of his treatise. I suspect that it originated as a quiet joke, a nickname for someone I envisage as a sort of Greco-Roman original of Shakespeare's Holofernes.

These works and the Pythagorean treatises seem, then, to inhabit different worlds. But a bridge can be found between them. In his shorter essay on harmonics, the *Enchiridion*, which survives intact, Nicomachus is again concerned mainly with the heroic figures of Pythagoras, Philolaus and Plato, and with the cosmic analogies of harmonic arithmetic. But this work, by contrast with most others in the same tradition, is intellectually quite undemanding. At the same time it has nothing of the tedious pedagogy of the Aristoxenian handbooks. It is intended neither for the schoolroom nor for the erudite specialist, but for the curious, generally educated amateur. It takes, in fact, the form of a letter to an unnamed 'noble lady', whom there is no reason to regard as a fiction,[10] and who had asked Nicomachus, as he tells us, to provide her with a simple, introductory account of these matters. It appears that she had heard him conversing learnedly on the subject, became intrigued and wished to know more. The fact that inspiring addresses given *viva voce* by experts in musical metaphysics were enthusiastically received in this period by lay people of high social standing is well attested in other sources too, notably in Plutarch and Athenaeus;[11] and the fact need not surprise us. It has often been remarked that in a period when political power had moved decisively away from local centres to Rome, from *polis* to empire and from senate to emperor, there was a strong tendency for people of the traditional governing classes to seek significance for themselves in some view, philosophical or religious, of the inner life of individuals, and of the individual's relation, by-passing political structures, to the universe at large, or to God.[12] To such tastes and cravings Pythagorean musical metaphysics made a strong appeal. But the simple point to which I want to draw attention here is that Nicomachus, when addressing such an audience, can apparently assume in his readership a basic familiarity with the conceptual apparatus of the other, Aristoxenian tradition of

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10 For discussion see Levin 1975: 16-20, with the remarks in the commentary to her translation (n. 2 above), pp. 34-5.

11 E.g., Athenaeus, *Deipn.* 624c-626a, Plutarch, *Non posse suaviter* 1095e-1096e.

12 For an illuminating study of the roles of Greek culture and language in this new kind of society, see Bowersock 1990.

harmonics. So too can a writer like Adrastus: he finds no need to *explain* the Aristoxenian scheme of things or to define its terms, but can simply call on them as he thinks fit.[13] And in fact the point can be taken further. A modest acquaintance with the terminology and major talking-points of musical analysis is demanded by the authors of literature of every sort in this period, even, for example, by so ingratiating and untechnical a writer as Dio Chrysostom.[14]

Educated Greeks in the early empire, then, and Latins too, to judge by references in Quintilian among others,[15] learned Aristoxenian harmonics at school; and as adults they were also liable to become enraptured by the dizzying metaphysical and quasi-religious speculations of mathematical professors in the high, Pythagorean tradition. These facts are interesting; but there would be nothing very odd about them if it were not for another general feature of early imperial harmonics, this one being shared in common by Pythagoreans and Aristoxenians alike.

The feature I have in mind is this. Musical practice had not stood still between the death of Alexander and the beginning of the Roman principate. Greek music itself had evolved new structures and usages, and in the wider empire Greeks and Romans had encountered, and absorbed, a variety of musical traditions originating in alien cultures.[16] Yet neither the intellectually adventurous Pythagoreans nor the Aristoxenian schoolbooks betray the smallest interest in these developments

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13 Adrastus's discussion at Theon Smyrn. 49.6-62.4, for instance, presupposes a substantial vocabulary of technical terms from the Aristoxenian repertoire. More striking still is the quite casual and unexplained introduction of a battery of names for specific notes, intervals and structures in Nicomachus *Ench.* 5, an avowedly elementary treatise in the mathematical style of harmonics. No one who was not already familiar with musicological terminology of the sort set out in the Aristoxenian handbooks could possibly make sense of it.

14 E.g., Dio Chrysostom 2.55-56, 34.52.

15 Particularly in *Inst. Or.* I.10.

16 There are good discussions of foreign influence and change in Baudot 1973: see also Comotti 1989: chap. 3; West 1992: chap. 12. Solid evidence of change is given by some of the surviving scores, most of which are collected in Pöhlmann 1970: see for instance West's remarks (1992: chap. 10) on the Song of Seikilos, *Pap. Osl.* 1413, *Pap. Mich.* 2958, etc.

or make the least attempt to analyse and explore them. In the case of the mathematical philosophers this is, perhaps, no great surprise. Their starting point is not what music is, but what it should be; and as far as they were concerned the structures and principles of rationally ideal musical systems had been captured for all time by the Classical pioneers, Philolaus, Archytas and especially Plato. It seems stranger that the exercises in musical analysis through which the children of prosperous Greeks and Hellenizing Romans were routinely dragged should also have remained doggedly focussed on forms of musical practice that were three hundred years out of date. But the answer to the puzzle is probably little different from the one I gave just now to account for the musical conservatism of the Pythagoreans. Educated Romans of this period were deeply and uneasily conscious of the superiority of the culture of a past age — though emphatically not the present age — of Greece; and Greeks in the Eastern empire were proud of their heritage and determined to preserve it.[17] Both knew that music had been credited with astonishing powers and placed at the core of the educational curriculum in the lost days of Athenian greatness. Plato said so; Aristophanes said so;[18] evidently the subject was a crucial key to the secrets of the civilized excellences which that age epitomised. What schoolchildren in the empire were being taught was not the means of understanding the music of their own society: it was conceived as one part of an initiation into the cultural forms of a golden age, whose heir the empire sought to become by implanting its traces in the souls of the new generation.

Yet the schooling that developed in response to this ambition bore virtually no resemblance at all to the musical education that had actually existed in classical Athens. When Aristophanes was a schoolboy, nothing remotely like 'musical theory', as we meet it in Bacchius and Gaudentius, had yet come into being. Even the model for the

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17 See for example Wardman 1976: esp. chaps. 1-2.

18 E.g., Aristophanes, *Clouds* 961-72, *Knights* 985-95, and by implication much of the last scene of *Frogs*; Plato, *Protagoras* 325d-326b, *Laws* 700a-701b. (If we include also Plato's educational recommendations, as well as his supposedly historical descriptions, there is of course much more material in *Republic* III and *Laws* II.)

handbook summaries, Aristoxenus, belongs to the late fourth century, when the old kind of musical education was already in tatters. There is no evidence that summary school texts were concocted out of Aristoxenus's writings in Hellenistic times. These things were new. My hypothesis is that when 'market forces' in the early empire created a demand for instruction in the old Hellenic wisdom, including musical wisdom, ingenious Greeks were ready, as ever, to devise a product that would meet the need. Education was by now based almost exclusively on written texts conveying their messages through language, and something had to be contrived that fitted the prevailing norms. Bowdlerised Aristoxenus was the answer.

We can criticize these writers, if we like, for reducing Aristoxenus's brilliant essays to a set of lifeless dogmas, and for neglecting the character of music in their own time. But their achievement should not be underestimated. If I am right, they were inventing a school discipline that was quite new, drawing on writings designed for entirely different purposes and conceived at a much higher level of intellectual sophistication, and reassembling them on the pedagogic model offered by other subjects in the curriculum. It cannot have been easy. And the second criticism misses the mark: these texts were never intended to bear on contemporary musical phenomena. They were planned from start to finish as an entrée, however misguided and artificial, to that elusive ancient-Greekness which was the badge of an educated person.

Three surviving treatises fall outside the scope of these remarks. The long work of Aristides Quintilianus can in some respects be regarded as the culmination of the tendencies I have been sketching; but it is rather later and very complex, and I shall not consider it here. The third of the anonymous essays collected by Bellermann is unique in being plainly designed, at least in part, for budding performers, not just as a detached scholastic exercise: it deserves careful study, but for now I must pass it by as well. Finally there is the great treatise of Claudius Ptolemaeus. His *Harmonics* deserves to stand beside the *Almagest* itself as one of the most important works of Greek science. Its methodological sophistication and self-consciousness, blending empiricist and rationalist principles into a compelling union, and its enunciation and pursuit of a genuinely experimental procedure that is startlingly modern both in overall conception and in detail, would by themselves be enough to earn it a distinguished place in the canon. From our present point of view it is also exceptional in its determination to analyse and account for musical systems in real contemporary use

— presumably those current in the music-mad city of Alexandria, Ptolemy's home.[19]

Ptolemy's work is a major contribution to harmonic science, and indeed to science, and the philosophy of science, in general. It merits far more attention than scholars have given it. But in the context of the present discussion it is quite untypical, a unique island of first-rate, hands-on scientific enquiry in a sea of musicological scholasticism. Our proper course here must be to give it the respectful salute it deserves, and sail on; but not before noticing one small way in which its existence helps to confirm the diagnosis I have offered of the aims of the other treatises. It might be argued that my diagnosis is improbably extreme: *no* direct connection with music in contemporary currency, no *intention* to make such a connection. Now because Ptolemy's methods, conclusions and conceptual apparatus are so distinctive, and because his work can be fairly securely dated, scholars have often tried to use it as a point of reference for dating other writings in harmonic science. Did the author know Ptolemy's work or not? It seems a sensible question; and yet this approach yields surprisingly meagre results. It is rare to find traces of Ptolemy's influence even in works that were certainly written later. But this fact at once ceases to be surprising if the purposes of those treatises differ from Ptolemy's in the quite radical way that my remarks have sketched.

A second possible response to my diagnosis would be to say that in that case these writings, whether Pythagorean or Aristoxenian, can hardly be allowed to count as works of science, in anything like our sense: they are nothing but deposits of tedious antiquarianism. The comment has some point. One should recognise, however, that in Pythagorean hands this musicological antiquarianism could provide the springboard for serious and original research in what seems to us a quite different domain, that of pure mathematics; and there is another way, too, in which the historical dimensions of harmonic analysis in this period turn out, in at least some cases, to be complemented and sustained by a genuinely scientific mode of investigation, rather than being inconsistent with it.

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19 On the musical tastes of the Alexandrians see e.g. Athenaeus, *Deipn.* 174b, 175e, and especially Dio Chrysostom 32.4-5, 20-21, 40-41, 46-47, 54-71. For Ptolemy's efforts to capture the structures of attunements current among practising musicians in his own time see *Harm.* I.16, II.16; cf. Barker 1991.

In order to show this, I want to devote the last phase of this paper to a brief case-study. The subject of my remarks does not quite fit either the Pythagorean or the Aristoxenian paradigm, as I have outlined them; from both a scientific and a musicological perspective he is more interesting than most examples of either. He seems to have been intelligently unimpressed by orthodox dogma on either side, though capable of drawing on significant aspects of both. But a scrutiny of his work will serve, I think, both to confirm the general tendency of the account I have been giving, and to help us see the harmonics of this period in a clearer and perhaps a more favourable light.

The name of this intriguing theorist is Didymus. This is not the famous Alexandrian scholar, 'Brazen-Guts' Didymus, but someone referred to by Ptolemy and his commentator Porphyry as Δίδυμος ὁ μουσικός, 'Didymus the music-specialist'. But the two Didymi may be connected. If, as is probable, our Didymus is the musical enthusiast who wrote a book on the Pythagoreans, and is located by the *Suda* in the time of Nero, his father was a certain Heraclides; and a Heraclides who wrote on music (one astute and reflective passage survives) is probably the same as one known to have studied with the famous Didymus in Alexandria. If the younger Didymus was reared in Alexandria, though on the likeliest interpretation of the rather confused notices in the *Suda* he later turns up in Rome, the fact would help to explain some of what we know about his work. If these speculations are on the right track, we have a scrap of 'real life' in which to frame the scientific record. We have a person brought up in a scholarly family with musical interests, in an erudite Alexandrian milieu, early in the first century AD. Later he moved to Rome, where if the *Suda* is to be trusted he gained something of a reputation, around the mid-century, as a practising musician as well as a scholar. We might guess that his activities, whatever they were, were coloured by his Alexandrian background and responded in some way to the interests of an educated circle in Neronian Rome.

Our detailed information comes from Ptolemy and Porphyry, each of whom evidently had at least one work by Didymus in his library. Porphyry alleges, not without malice, that 'much if not all' of the substance of Ptolemy's *Harmonics* is derived without acknowledgement from Didymus.[20] In view of what I have said about the stature of

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20 Porphyry, *Comm.* 5.7-15.

Ptolemy's work, this would be genuinely astonishing, if it were true, and we should probably not take the allegation too seriously; but it could only have been colourable if Didymus's work was substantial in scope and intellectually ambitious, and if his project had at least some recognisable affinities with Ptolemy's. Porphyry also preserves two longish passages from Didymus which discuss the differences of approach between various traditions of harmonic science, especially though not exclusively the Aristoxenians and Pythagoreans.[21] The passages are impressive: Didymus had evidently thought hard about these matters. His reflections apparently began from the similar but briefer discussions of a certain Ptolemaïs of Cyrene, the only known female musicologist of antiquity: Didymus is probably Porphyry's source for the passages he quotes from her.[22] One other reference in Porphyry deserves recording. It shows that Didymus was Porphyry's source also for information about the curious practices of some early Pythagoreans, and that Didymus claimed to have found the information in a work by Archytas of Tarentum, who was reporting the practices of *his* contemporaries or predecessors.[23] In that case, Didymus apparently did some serious historical research, and had access to some rather unusual documents: this is where his early connection with the Alexandrian library may be relevant. Secondly, Archytas is a pivotal figure in the work of Ptolemy himself. Ptolemy discusses him at length, and takes an approach to harmonics which is closer to the one he attributes to Archytas than it is to any other. He certainly knew the passage which Porphyry reports, since he criticises the procedures it describes in some detail.[24] It is at least a plausible guess, then, that Didymus was Ptolemy's prime source of information and comment about Archytas, the theorist he most nearly resembles; and if the bones of Ptolemy's approach could have been excavated from Didymus's analysis of Archytan procedures, this might go some way towards explaining Porphyry's charge of plagiarism.

To sum up the material we have reviewed so far: if the *Suda*'s Neronian Didymus is our man, he was known as a performer as well as

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21 Porphyry, *Comm.* 26.2-29, 27.17-28.6, trans. in *GMW* 2: 242-4.

22 Porphyry, *Comm.* 22.22-23.22, 23.24-24.26, 25.3-26.5, trans. in *GMW* 2: 239-42.

23 Porphyry, *Comm.* 107.15-108.21, trans. in *GMW* 2: 34-5.

24 Ptolemy, *Harm.* I.6.

a theorist and scholar. He had studied the history of harmonics, and had found things to interest him in works dating from the fourth century. He was knowledgeable about Aristoxenus, and had access to writings, now lost, which at least purported to be those of Archytas. The record he made of his historical researches was substantial enough to serve as a major source of information about the early period for both Ptolemy and Porphyry. He pursued questions about the methodology of the science, examining here again the work of the fourth-century pioneers, and his comments show him to be well informed and perceptive. Let us now add two further points drawn from Ptolemy himself. Ptolemy refers rather rarely to his predecessors by name, and Didymus shares with Archytas and Aristoxenus the unusual distinction not only of being named, but of having a substantial Ptolemaic passage devoted to his work. It shows that in addition to his other activities, Didymus also attempted his own original contributions to harmonic theory, offering harmonic 'divisions', that is, mathematical representations of systems of attunement, which differ interestingly from those of all other authorities; and it shows, secondly, that he suggested and apparently put into practice certain novel techniques for using the harmonic scientist's 'laboratory' instrument, the monochord.[25] A closer look at these last two points will help us, I believe, to make sense of Didymus's work as a whole, and of its relation to the general run of both Pythagorean and Aristoxenian treatises in this period.

The obvious question to ask about any new proposals for the 'correct' division of harmonic space is what their credentials are, why the theorist believes they should be preferred to existing analyses. Didymus's supporting arguments have unfortunately not survived, but there is information to be wrung from the divisions themselves. I shall spare you the mathematical detail: the main points can be made without getting into recondite technicalities. First, then, these divisions are presented as systems of ratios. As such they belong on the 'Pythagorean' side of the Aristoxenian/Pythagorean divide; and they can be precisely interpreted in terms of relative lengths of string on a monochord. More of that shortly. Secondly, all the ratios involved have the special mathematical form that was accorded a privileged position in all versions of Pythagorean harmonics, but which was the source of much more stringent rules of harmonic

25 Ptolemy, *Harm.* II.13-14.

formation in a special channel of the tradition, one that stems from Archytas and is later pursued by Ptolemy.[26] The fact is important: Ptolemy apart, all relevant theorists, even including Archytas himself, allow exceptions to these rules. Didymus did not: he evidently took rather seriously the mathematical reflections that marked this class of ratios out as peculiarly satisfactory in a musical context. Here again, we may remark in passing, we find a feature of Didymus's work that might underlie Porphyry's innuendo about Ptolemy's unacknowledged borrowings.

The third point is particularly striking. Despite the Pythagorean style of his approach, and unlike most others from that stable, the systems that Didymus's divisions generate have significant affinities with those of Aristoxenus. Now an attempt to represent Aristoxenian systems in Pythagorean mathematical guise had been made, I believe, much earlier, by Eratosthenes in the third century BC. Echoes of it appear in Ptolemy, and we may fairly guess that he got his knowledge of it from Didymus. But the Eratosthenean-Ptolemaic attempt to reproduce Aristoxenus's intervals in relative lengths of string on a monochord is hopelessly flawed from a mathematical point of view; and if he knew of it, Didymus quite rightly rejected it.[27] What he did instead was to reproduce in his divisions not the exact intervals, but certain key structural features of the principal Aristoxenian systems, particularly those that relate the three main systems to one another. These relations are faithfully echoed in Didymus's divisions, and in no other divisions presented by ancient

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26 That is, they are all 'epimoric' (or in the Latin jargon, 'superparticular') ratios, recognisable by the fact that they are all of the form (n+1):n. (More technically, they are those ratios in which the difference between the two terms is an integral factor of the smaller.) All mathematical harmonic theorists accorded them special status, particularly in connection with the concords: see e.g. the introduction to the Euclidean *Sectio Canonis* (printed in *MSG* and *MMG*, translated in *GMW* 2); text, translation and full discussion in A. Barbera, *The Euclidean Division of the Canon* (Lincoln and London 1991); Ptolemy *Harm.* I.5-6. Some, such as Archytas (see Ptolemy, *Harm.* I.13, with the discussion at *GMW* 2: 46-52) and I think Eratosthenes (Ptolemy, *Harm.* II.14) gave them still greater importance. Those to whom I refer here, Didymus and Ptolemy himself, required that every well-formed scalar step in every musical system should have a ratio of this sort (see especially *Harm.* I.7 and I.15 for Ptolemy, the tables in II.14 for Didymus).

27 See Ptolemy, *Harm.* II.13-14, with *GMW* 2: 345 n. 112, 346 nn. 116, 117.

writers in the language of Pythagorean ratios.[28] We may judge, then, that Didymus was aiming to find a set of ratio-systems which simultaneously obeyed the rules of Pythagorean mathematics in their strictest and historically most authentic form, and preserved the essential features of the attunements said by Aristoxenus to have been those of real Greek practice, in his own and earlier times.

To get at the last group of points I want to make, we must now look at Didymus's suggestions about the use of the monochord. The monochord is a simple device, little more than a string stretched above a flat base on which measurements of length are marked. A moveable bridge divides off the section of string to be sounded, and the interval between

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28 The relevant facts can be gleaned from the tables in Ptolemy, *Harm.* II.14. The correspondences between Didymus and Aristoxenus deserve recording, but I cannot express them briefly without drawing on a moderately technical vocabulary. For those conversant with the terminology, or prepared to fortify themselves in advance by reading (e.g.) *GMW* 2: 11-13 or West 1992: 160-2, the most significant points are these. (a) In Didymus, as in Aristoxenus, the lowest interval in the diatonic tetrachord is identical with that in the chromatic, and equal to the sum (in terms of ratios, the product) of the two lowest intervals in enharmonic, the enharmonic *pyknon*. (Here and subsequently, I treat Aristoxenus's 'tense' diatonic and 'tonic' chromatic as the standard Aristoxenian forms, as did most writers of the imperial period.) (b) As a consequence, in both authors, the sum of the two highest intervals in diatonic is equal to its counterpart in chromatic, and to the highest single interval in enharmonic. (c) The curiously small interval in the middle of Didymus's chromatic (6:5 x 25:24 x 16:15) is explained by his decision to follow Aristoxenus in making the highest chromatic interval the sum of a tone and the lowest interval in diatonic or chromatic (the interval discussed in [a] above). I can think of no other reason why he avoided the more natural-looking chromatic division — given the ratio 16:15 for the lowest interval — of 7:6 x 15:14 x 16:15, which is equally well qualified in the respects discussed in n. 30 below. (That 7:6 is acceptable in this position is shown by its presence there in one of Ptolemy's own chromatic divisions.) (d) In adopting the ratio 5:4 for the highest interval in enharmonic, instead of the (marginally different) 81:64 implied by Aristoxenus, Didymus may have been not only following Pythagorean 'rules' (as he certainly was), but also noting Aristoxenus's remarks at *El. Harm.* 23.1-23 about the tendency of performers in his time to 'sweeten' this interval by reducing it slightly from the true ditone that it 'should' be. (See notes *ad loc.* in *GMW* 2, and Winnington-Ingram 1932.) In connection with both (c) and (d), Didymus may well have thought of himself as simultaneously upholding mathematical principles attributable to Archytas, and improving on Archytas in the degree of 'fit' between his divisions and the data of fourth-century practice, in the light of his study of Aristoxenus.

any two notes is determined by the ratio between the lengths of string that sound them. Hence any scale system worked out mathematically, and represented as a sequence of ratios, can be presented by means of this instrument in audible form to the ear. It is the basis, for instance, of the experimental tests carried out by Ptolemy; and it can be used with great precision. But as Ptolemy himself points out, it is cumbersome in practice. Every new note needs a new position of the moveable bridge, and positioning it exactly is an operation of some delicacy, hard to do quickly, and quite impracticable if one goes beyond the demonstration of scale-systems to the performance of any rhythmically or melodically complex music. What Didymus noticed, according to Ptolemy, is that the difficulties can be eased if the player learns to use sections of string on *both* sides of the bridge as sounding lengths, so that every bridge-position can generate two notes instead of one.[29]

This does not sound like a great advance: the limitations of the instrument are still pretty severe. But if we look again at Didymus's divisions in the light of this information, something rather remarkable emerges. I said earlier that all the ratios of these divisions have the form which Archytas and others reckoned peculiarly appropriate to musical intervals. Now when we calculate the ratios between lengths left on the *other* side of the bridge from the one on which Didymus's basic scales are played, it emerges that every one of them is also a ratio of this privileged kind.[30] Hence, if the player adopts Didymus's new procedure

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29 For Ptolemy's general account of the monochord, see *Harm.* I.8 and compare I.11. His references to Didymus's improvements in playing technique are in II.13.

30 Imagine the stretched string of a monochord, with a bridge dividing it exactly in half. The segments of string on each side of the bridge are the same length (call this length L) and sound the same pitch. Now move the bridge to the right, so that the new length to the left of the bridge is (for instance) nine eights of L. This will create the first downwards step in the diatonic sequence (ratio 9:8). Now consider the relation between L and the new distance to the right of the bridge. While the distance to the left of the bridge has been increased by one eighth (for instance from 120 units to 135), that on the right has been reduced by one eighth (from 120 to 105), so that the ratio of the interval produced on the right hand side is 8:7. From here on the relationships become more complicated. When the length to the left is again increased to make the next diatonic step (10:9), increasing 135 by one ninth to 150, the length on the right is simultaneously reduced by one seventh, from 105 to 90, and the ratio created on the right, between 105 and 90, is 7:6. Let us call the ratio produced on the right, simultaneously with any new step in Didymus's sequence

on the instrument, all of these other lengths can also be used in legitimately musical sequences. This is no sort of mathematical banality. Ptolemy records a total of fifteen different harmonic divisions expressed in terms of ratios, including his own and the three attributed to Didymus. All three of Didymus's divisions satisfy the condition in question. But it turns out, if we do the sums, that of the other twelve only another three do so; and they are randomly distributed among the offerings of different theorists — one attributed to Archytas, one to Eratosthenes, and one adopted as a rather anomalous theoretical possibility by Ptolemy himself.[31] Given these statistics, it is wildly unlikely that this feature of Didymus's systems is accidental.

Let me pursue this matter just one stage further. It turns out that all the intervals that Didymus's systems require can be constructed, in the right order and on the same side of the bridge, from just six positions of the bridge, which is tolerably economical. But if we consider the lengths generated from these six positions on *both* sides of the bridge, a whole array of ratios of the right mathematical sort can be produced. If we take the series of such ratios in the order in which a Pythagorean mathematician would have listed them (2:1, 3:2, 4:3, 5:4, and so on), the first nine of them are all available to the Didyman monochordist, along with a total of six others. Between them they give correct values for the octave, perfect fifth, perfect fourth, all the canonical versions of the third and the tone (or 'major second'), four variants of the half-tone and two approximations to the quarter-tone. From Didymus's six positions of the bridge, then, his procedure generates fifteen mathematically well-formed me-

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as it unfolds on the left, the 'counterpart' of that step. Then the counterparts of the 5:4, 31:30, 32:31 in his enharmonic are 4:3, 18:17, 17:16. Those of the 6:5, 25:24, 16:15 in his chromatic are 5:4, 16:15, 9:8. Those of the 9:8, 10:9, 16:15 in his diatonic are 8:7, 7:6, 9:8. All these 'counterpart' ratios are of the proper epimoric form, (n+1):n. In each case, the interval between the lowest note generated on the left and the highest on the right is an octave (ratio 2:1). From the original note given by length L to the bottom is always a perfect fourth (4:3), and to the top is a fifth (3:2). By compounding pairs of adjacent ratios appropriately, we can find the same overall structure in each of the divisions constituted by the combination of original ratios and counterparts: from the top downwards it is always 9:8, 4:3, 5:4, 16:15. It is all remarkably neat.

31 They can be found in the tables of *Harm.* II.14: the enharmonic of Archytas, the chromatic of Eratosthenes, and the curious 'even diatonic' of Ptolemy (on which see *Harm.* I.16).

lodic steps, while simultaneously putting in place well-considered representations of the musical systems described by Aristoxenus.[32]

It seems clear that Didymus's mathematical divisions and his improvements to monochord technique belong very closely together. So why? What was the point? One *might* guess that he, like Ptolemy after him, was concerned to use the instrument as a device for testing the credentials of his theoretical systems, by presenting them experimentally to the judgement of the ear. But this suggestion gets into several kinds of trouble. One is that what is needed for these purposes on the monochord is not ease of manipulation so much as maximal precision — a result that Ptolemy moves mountains to secure, but which is not in the least enhanced by Didymus's procedures. Secondly, there is nothing in our accounts of Didymus to suggest that he sought to produce attunements familiar and acceptable to the contemporary ear. That is a central Ptolemaic objective. But Didymus seems bent on a different target, that of reconstructing scientifically the systems propounded by Aristoxenus some three-and-a-half centuries earlier. Thirdly, as Ptolemy's own remarks confirm, Didymus's alterations to methods of using the monochord will count as improvements only in the sense that they make it easier to *play music* on it, actually to perform melodies, a task for which it was rarely used, and which for Ptolemaic scientific purposes seems quite irrelevant.

We must accept that Didymus, like so many of his contemporaries, was not concerned with the scientific analysis of the music of his own time; and that in his hands the monochord was not a device through which contemporary ears were to judge how well his mathematically excogitated systems fitted the musical patterns with which they were familiar. The accuracy of his Aristoxenian reconstructions could hardly

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32 If we take a length of 120 units as our starting point (so that the whole string is 240 units long: see n. 30 above), the six positions are those giving lengths of 120 (on both sides of the bridge), 135 (counterpart 105), 144 (counterpart 96), 150 (counterpart 90), 155 (counterpart 85) and 160 (counterpart 80). The ratios produced, either individually or by compounding groups of adjacent ratios, are in enharmonic 2:1, 3:2, 4:3, 5:4, 9:8, 16:15, 17:16, 18:17, 31:30, 32:31, in chromatic some of the same but also 6:5, 10:9, 25:24, and in diatonic, additionally, 7:6 and 8:7. Hence the complete set is 2:1 (octave), 3:2 (fifth), 4:3 (fourth), 5:4, 6:5, 7:6 (forms of the third), 8:7, 9:8, 10:9 (forms of the tone), 16:15, 17:16, 18:17, 25:24 (forms of the 'semitone'), 31:30, 32:31 (forms of the 'quarter-tone').

be judged by the impression they made on listeners in the first century AD. It seems clear that we are back among the scenery from which we began. Didymus's project was first to recreate the attunements of Aristoxenus's time as accurately as possible by mathematical means, and then to use his monochord to present to an audience actual melodies based in these attunements, with the intention, I suggest, of showing his contemporaries what the revered music of Greek antiquity had really been like.

In the context of a culture inclined to treat classical Greece as the pinnacle of refined civilisation, and its music as little short of miraculous in its powers, Didymus's project makes excellent sense. Classical Greek literature could be read, but the sounds of its music had long been lost, and many writers lament the fact that contemporary music lacks all the great qualities attributed to its Hellenic counterpart. What then could be more desirable than the recreation of this music on a solid historical and scientific basis? Didymus's procedure in pursuing his quarry is equally intelligible. His methodological researches convinced him that the only reliable source of empirical data was Aristoxenus. But the language of Aristoxenus's descriptions is too imprecise for the exact nuances of his attunements to be read off from them without further ado. Scientific detective-work was called for; and here Didymus turned to the principles of Pythagorean theory — the appropriate matrix, by the standards of his time, for all high-level scientific study in this field. By applying the rules he discovered in fourth-century Pythagorean mathematics to the structural essentials of the empirical data set out by Aristoxenus, he came up with a set of systems admirably consistent with both. The resulting analyses could be conceived both as preserving the structures of the music actually performed in ancient Greece, and as having the mathematical properties that could link them with current metaphysical speculations, which sought to account for their extraordinary moral, psychological and cosmic powers.

Finally, he developed a new way of using the monochord which was peculiarly well suited to the performance of melodies in just those systems of attunement that his researches had uncovered. Of these two things, the monochord technique and the postulated musical systems, we cannot confidently say which is chicken and which is egg: it would certainly have been tempting to adjust his theoretical results, if necessary, to suit the tricks of practical performance. But the consequence, in any case, was that his reconstructed 'music of the golden age' could now be played and heard once again. With modern hindsight we may have legitimate doubts about the reliability of his methods and findings. But

this triple combination of scientifically grounded historical authenticity, practical performability, and mathematical precision allied to metaphysical significance must be reckoned a notable achievement, and one perfectly suited to the temper of his times. History does not inform us, unfortunately, whether the tunes that Didymus played struck his hearers as possessing the aesthetic excellence and psychic power that legend credited to the melodies they sought to recreate. Nor does it tell us whether they came to the notice of the man who, by his own reckoning, was the greatest Hellenic musician of them all, the emperor Nero himself. If they did, the scene that followed would have provided wonderful opportunities for the pen of Suetonius, with the trembling musicologist presenting the results of his researches to his imperial master, and Nero struggling to get his voice around the unfamiliar nuances of scale and interval. But I'm afraid you will have to imagine the episode for yourselves, since unaccountably and most regrettably Suetonius overlooked it. Or perhaps it never happened, and Didymus may have been lucky that it didn't. It would, one suspects, have been an uncomfortable and hazardous interview.

Abbreviations

GMW 1, 2	A. Barker, *Greek Musical Writings*. 2 vols. Cambridge, 1984, 1989.
MMG	L. Zanoncelli, *La Manualistica Musicale Greca*. Milan, 1990.
MSG	C. von Jan, *Musici Scriptores Graeci*. Leipzig, 1895.

Bibliography

(Editions and translations of single authors and texts are in principle excluded)

A. Barker 1991. 'Reason and perception in Ptolemy's Harmonics', *Harmonia Mundi*, ed. R. Wallace & B. MacLachlan. *Biblioteca di Quaderni Urbinati di Cultura Classica* 5. Rome, 104-130.

A. Baudot 1973. *Musiciens romains de l'antiquité*. Montreal.

A. Bélis 1986. *Aristoxène de Tarente et Aristote: Le traité d'harmonique*. Paris.

G.W. Bowersock 1990. *Hellenism in Late Antiquity*. Ann Arbor.

W. Burkert 1972. *Lore and Science in Ancient Pythagoreanism*, trans. E.L. Minar. Cambridge, MA.

G. Comotti 1989. *Music in Greek and Roman Culture*, trans. R.V. Munson. Baltimore & London.

F.G. Kenyon 1909. 'Two Greek school tablets', *Journal of Hellenic Studies* 29, 29-40.

F.R. Levin 1975. *The Harmonics of Nicomachus and the Pythagorean Tradition*. American Classical Studies 1. Philadelphia.

H.I. Marrou 1956. *A History of Education in Antiquity*, trans. G.R. Lamb. London.

E. Pöhlmann 1970. *Denkmäler altgriechischer Musik*. Nuremberg.

O. Steinmayer 1985. 'Bacchius Geron's *Introduction of the Art of Music*', *Journal of Music Theory* 29, 271-298.

O. Strunk 1981. *Source Readings in Musical History* 1. London & Boston.

A. Wardman 1976. *Rome's Debt to Greece*. London.

M.L. West 1992. *Ancient Greek Music*. Oxford.

R.P. Winnington-Ingram 1932. 'Aristoxenus and the intervals of Greek music', *Classical Quarterly* 26, 195-208.